



## TRANSLATION

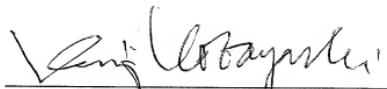
Kenji Kobayashi, residing at 2-46-10 Goko-Nishi, Matsudo-shi, Chiba-ken, Japan, state:

that I know well both the Japanese and English languages;

that I translated, from Japanese into English, the specification, claims, abstract and drawings as filed in U.S. Patent Application No. 09/506,327, filed February 18, 2000; and

that the attached English translation is a true and accurate translation to the best of my knowledge and belief.

Dated: May 30, 2000



Kenji Kobayashi

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TITLE OF THE INVENTION

## IMAGE FORMING APPARATUS

## BACKGROUND OF THE INVENTION

The present invention relates to an image forming apparatus and, more particularly, to an improvement in the developer replenishment mechanism of the image forming apparatus.

An image forming apparatus for forming an electrostatic latent image on an image carrier, developing the image with toner in a developing unit, and transferring the toner image onto a sheet, comprises a container (toner cartridge or toner bottle) for replenishing the developing unit with toner. This toner cartridge has a spiral on its inner surface. When the toner cartridge itself rotates, the contained toner is squeezed out from an outlet port along the spiral and supplied to the developing unit.

The outlet port of the toner cartridge is open in mounting a new toner cartridge on the apparatus main body or dismounting an empty toner cartridge from the apparatus main body. For this reason, toner escapes from the outlet port and scatters in the apparatus to contaminate the apparatus.

## BRIEF SUMMARY OF THE INVENTION

25 It is an object of the present invention  
to provide a developer cartridge which prevents  
a developer from escaping from a outlet port and

scattering in an apparatus in mounting/dismounting  
on/from the apparatus main body.

It is another object of the present invention to  
provide an image forming apparatus having the developer  
5 cartridge which prevents a developer from escaping from  
the outlet port and scattering in the apparatus in  
mounting/dismounting on/from the apparatus main body.

According to the present invention, there is  
provided a developer cartridge which is rotatably  
10 mounted in a developing unit of an image forming  
apparatus, and supplies a developer to the developing  
unit while rotating, comprising a cylindrical cartridge  
main body having a developer outlet hole in an outer  
surface near one end, and a ring-like cartridge-side  
15 shutter which is fitted on the outer surface near one  
end of the cylindrical cartridge main body to be  
movable along a rotating shaft of the cylindrical  
cartridge main body between a position where the  
developer outlet hole is opened and a position where  
20 the developer outlet hole is closed, wherein the  
developing unit has a guide for inserting the developer  
cartridge and a driving unit for rotating the developer  
cartridge, the guide has a main body-side shutter with  
a hole, and when the developer cartridge is mounted,  
25 the cartridge-side shutter of the cylindrical cartridge  
main body moves from the position where the developer  
outlet hole is closed to the position where the

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developer outlet hole is opened, the developer outlet hole aligns itself with the hole of the main body-side shutter, and every time the cylindrical cartridge main body and the main body-side shutter integrally rotate to align the developer outlet hole and the hole of the main body-side shutter with a developer replenishment port formed below the main body-side shutter, the developer in the developer cartridge is supplied from the developer replenishment port to the developing unit via the developer outlet hole and the hole of the main body-side shutter.

According to the present invention, there is provided an image forming apparatus comprising a developing unit for developing an electrostatic latent image on an image carrier with a developer, and a transfer unit for transferring the developed developer image onto a transfer medium, wherein the developing unit has a developer cartridge rotatably mounted to supply the developer to the developing unit while rotating, a guide for inserting the developer cartridge, and a driving unit for rotating the developer cartridge; the developer cartridge has a cylindrical cartridge main body having a developer outlet hole in an outer surface near one end, and a ring-like cartridge-side shutter which is fitted on the outer surface near one end of the cylindrical cartridge main body to be movable along a rotating

shaft of the cylindrical cartridge main body between  
a position where the developer outlet hole is opened  
and a position where the developer outlet hole is  
closed; the guide has a main body-side shutter with  
5 a hole; and when the developer cartridge is mounted,  
the cartridge-side shutter of the cylindrical cartridge  
main body moves from the position where the developer  
outlet hole is closed to the position where the  
developer outlet hole is opened, the developer outlet  
10 hole aligns itself with the hole of the main body-side  
shutter, and every time the cylindrical cartridge main  
body and the main body-side shutter integrally rotate  
to align the developer outlet hole and the hole of the  
main body-side shutter with a developer replenishment  
15 port formed below the main body-side shutter, the  
developer in the developer cartridge is supplied from  
the developer replenishment port to the developing unit  
via the developer outlet hole and the hole of the main  
body-side shutter.

20 Additional objects and advantages of the invention  
will be set forth in the description which follows, and  
in part will be obvious from the description, or may be  
learned by practice of the invention. The objects and  
advantages of the invention may be realized and  
25 obtained by means of the instrumentalities and  
combinations particularly pointed out hereinafter.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate presently preferred embodiments of the invention, and together with the general description given above and the detailed description of the preferred embodiments given below, serve to explain the principles of the invention.

FIG. 1 is a sectional view showing the schematic structure of an image forming apparatus according to an embodiment of the present invention;

FIG. 2 is an exploded perspective view showing a toner replenishment unit of the image forming apparatus according to the embodiment of the present invention;

FIGS. 3A and 3B are views showing a state in which a toner cartridge is mounted in the toner replenishment unit;

FIGS. 4A and 4B are perspective views showing a state in which the toner cartridge of the image forming apparatus according to the embodiment of the present invention is positioned by an inlet guide to mesh with a driving unit;

FIGS. 5A, 5B, and 5C are schematic views showing exchange of the toner cartridge;

FIG. 6 is a perspective view showing a toner cartridge according to the embodiment of the present

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invention;

FIG. 7 is a perspective view showing a state in which a cartridge-side shutter covers a toner outlet port in the toner cartridge according to the embodiment of the present invention;

FIG. 8 is a perspective view showing a toner cartridge driving mechanism on the apparatus main body side according to the embodiment of the present invention;

FIG. 9 is a perspective view showing a toner cartridge according to another embodiment of the present invention;

FIG. 10 is a sectional view showing part of a toner cartridge according to still another embodiment of the present invention; and

FIG. 11 is a perspective view showing part of the toner cartridge according to still another embodiment of the present invention.

#### DETAILED DESCRIPTION OF THE INVENTION

Preferred embodiments of the present invention will be described below with reference to the several views of the accompanying drawing.

FIG. 1 is a sectional view showing a whole copying machine according to a preferred embodiment of the present invention. In FIG. 1, a copying machine 1 comprises at its lower portion a cassette sheet feeder 2 which stores many sheets. The copying machine 1

further comprises an LCF sheet feeder 3 for feeding many sheets of the same size, and a manual sheet feeder 4 capable of feeding various kinds of sheets.

The copying machine 1 comprises at its upper  
5 portion an image reading section 5 for reading a document, an automatic document feeder 6 for feeding a document to the image reading section 5, an image storage section 7 for storing image data read by the image reading section 5, and a laser optical device for reading out the stored image data and writing the image  
10 on an image forming section 8.

The image forming section 8 is made up of a photosensitive drum 10, developing unit 11, cleaner 12, charger 13, discharge lamp 14, and transfer/separation  
15 charger 15. The developing unit 11 is equipped with a toner cartridge 16 for replenishing the developing unit 11 with toner, and a driving unit 17 for driving the toner cartridge 16, as shown in FIG. 3A.

As shown in FIG. 3B, the outer surface of the  
20 toner cartridge 16 near its end has a projection 24 for positioning the toner cartridge 16 in mounting it on the copying machine main body. The projection 24 stands at a predetermined position with respect to an outlet hole 21 formed in a cap (constricted portion) 20.

FIG. 2 is an exploded perspective view showing the toner replenishment unit of the copying machine main

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body. FIGS. 3A and 3B are views showing a state in which the toner cartridge is mounted in this toner replenishment unit.

In FIG. 2, an inlet guide 18 is attached to  
5 the copying machine main body, and has a guide hole  
of a size enough to receive the toner cartridge 16.  
As shown in FIG. 3B, a recess 25a is formed at a  
predetermined position of the guide hole. The recess  
25a fits with the projection 24 formed on the toner  
10 cartridge 16.

A mounting lever 25b is attached to the inlet  
guide 18. Upon mounting the toner cartridge 16, the  
mounting lever 25b presses the end of the toner  
cartridge 16 so as to prevent the toner cartridge 16  
from popping out. A spring 26 for pressing the toner  
cartridge 16 into the copying machine main body is  
15 attached between the mounting lever 25b and the toner  
cartridge 16.

As shown in FIG. 3A, the copying machine main  
20 body also comprises the driving unit 17 for rotating  
the toner cartridge 16. As shown in FIG. 2, the  
driving unit 17 is constituted by a motor 27, belt 28,  
pulley 29, driving gears 30 and 31, convey auger 32,  
driving gears 33 and 34, spring 35, driving plate 36,  
25 holder guide 37, holder 38, and holder cover 39.

In this driving unit 17, the motor 27 rotates the  
pulley 29 via the belt 28 to rotate the driving gear 30

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meshed with the pulley 29. The driving gear 30 meshes with the driving gears 31 and 33. The convey auger 32 is attached to the driving gear 31 and rotated by it.

The driving gear 33 meshes with the driving gear 34, to which the driving plate 36 is attached. The driving plate 36 has a driving hole for driving the toner cartridge 16. The driving gear 34 has an elliptical hole. The shaft of the driving plate 36 extends through the elliptical hole to allow the driving gear 34 to slide axially with respect to the driving plate 36. The driving hole of the driving plate 36 is formed at a predetermined position with respect to the elliptical hole of the driving gear 34.

The holder guide 37 also has an elliptical hole. The shaft of the driving plate 36 extends through this elliptical hole to connect the holder guide 37 to the driving gear 34. The holder guide 37 rotates integrally with the driving plate 36 by rotation of the driving gear 34.

The holder guide 37 has a toner replenishment hole 40, which is formed at a predetermined position with respect to the elliptical hole. A projection 41 stands at a predetermined position with respect to the elliptical hole of the driving shaft 34.

As shown in FIG. 3A, the toner cartridge 16 is mounted in the copying machine 1 after the mounting lever 25b on the front of the copying machine 1 is

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released. At this time, the projection 24 of the toner cartridge 16 meshes with the recess 25a at the guide hole of the inlet guide 18.

The recess 25a is formed at, e.g., an upper portion of the guide hole of the inlet guide 18, and the projection 24 of the toner cartridge 16 corresponds in position with the recess 25a. The cap 20 of the toner cartridge 16 has the outlet hole 21 and a projection 22 at predetermined positions.

10 The toner cartridge 16 is positioned by the inlet guide 18 to mesh with the driving unit. That is, by positioning the toner cartridge 16 in this manner, the toner replenishment port 40 of the holder guide 37 of the driving unit 17 aligns itself with the outlet port 21 of the cap 20 to enable toner replenishment. 15 At the same time, the projection 22 of the cap 20 fits in the driving hole of the driving plate 36 to enable rotating the toner cartridge 16 by the driving unit 17.

FIGS. 4A and 4B show a state in which the toner cartridge 16 is positioned by the inlet guide 18 to fit with the driving unit. FIG. 4A shows a state in which the inlet guide 18 and holder 38 are mounted, and FIG. 4B shows a state in which the inlet guide 18 and holder 38 are dismounted to expose the convey auger 32.

25 FIGS. 5A to 5C are schematic views showing exchange of the toner cartridge 16.

When toner in the toner cartridge 16 mounted in

CONTINUATION SHEET

the copying machine goes empty, an empty sensor arranged in the developing unit 11 displays an empty display on the control panel of the copying machine 1. Then, the user opens the front cover of the copying machine 1 to pull out the toner cartridge 16 axially (to the right on the page).

The toner cartridge 16 is pulled in a direction indicated by an arrow (to the right) from the state shown in FIG. 5A in which the toner cartridge 16 is mounted in the copying machine. FIG. 5B shows a state in which the toner cartridge 16 is pulled by 4 or 5 mm. In this state, the driving gear 34 is pressed to the right by the operation of the spring 35 to release the meshing between the driving gears 33 and 34. Hence, no rotation driving force is transferred from the driving gear 33 to the toner cartridge 16.

Further, the toner cartridge 16 is pulled to the right. FIG. 5C shows a state in which the toner cartridge 16 is pulled by 7 mm from the state of FIG. 5A. In this state, the toner cartridge 16 is disengaged from the driving plate 36.

After the toner cartridge 16 is dismounted, a new toner cartridge is mounted in the copying machine. The mounting procedures are reverse to the dismounting procedures described with reference to FIGS. 5A to 5C.

More specifically, the toner cartridge 16 is set at a predetermined position in the machine main body

(state shown in FIG. 5C), and pressed axially  
to the left on the page). Then, the projection 22 of  
the cap 20 fits in the driving hole of the driving  
plate 36 (state shown in FIG. 5B). In this state,  
5 however, the driving gears 33 and 34 do not yet mesh  
with each other.

The toner cartridge 16 is further axially pressed,  
and the driving plate 36 and driving gear 34 move to  
the left against the repulsion force of the spring 35.  
10 The driving gear 34 meshes with the driving gear 33 to  
allow rotation of the toner cartridge 16 by the driving  
unit 17.

In this case, as described above, the toner  
replenishment port 40 (not shown in FIGS. 5A to 5C)  
15 of the holder guide 37 aligns itself with the outlet  
port 21 (not shown in FIGS. 5A to 5C) of the cap 20 to  
enable toner replenishment.

FIG. 6 is a perspective view showing a toner  
cartridge according to the embodiment of the present  
invention. In FIG. 6, a toner cartridge 100 has  
20 a toner outlet port 101 on the side surface of  
a constricted portion which is formed at one end of  
a toner cartridge 100 and inserted into the inlet  
guide 18. A spiral is formed on the inner surface of  
25 the toner cartridge 100. Rotation of the toner  
cartridge 100 squeezes toner in the toner cartridge 100  
along the spiral, and when the toner outlet port 101

faces down, the toner is discharged from the toner outlet port 101.

The constricted portion at one end of the toner cartridge 100 is equipped with a cartridge-side shutter 102. As shown in FIG. 7, the cartridge-side shutter 102 covers the toner outlet port 101 before mounting the toner cartridge 100 in the machine main body or after dismounting it.

A toner scattering prevention seal 103 is attached to the toner outlet port 101 of the constricted portion at one end of the toner cartridge 100.

The cartridge-side shutter can have a through hole. That is, before the toner cartridge 100 is mounted in the machine main body, the cartridge-side shutter covers the toner outlet port 101. In mounting, the cartridge-side shutter moves axially to align the through hole with the toner outlet port 101.

FIG. 8 is a perspective view showing a toner cartridge driving mechanism on the machine main body side. In FIG. 8, a main body-side toner cartridge driving mechanism 200 has a coupling structure formed integrally with a main body-side shutter 201, which has a main body-side shutter opening 202. The constricted portion at one end of the toner cartridge 100 fits with the main body-side shutter 201 so as to align the toner outlet port 101 with the main body-side shutter opening 202. Accordingly, the toner cartridge 100 is

mounted in the machine main body.

Before the toner cartridge 100 is mounted in the machine main body, the cartridge-side shutter 102 covers the toner outlet port 101, as shown in FIG. 7.

5 In mounting, the cartridge-side shutter 102 is pressed by the main body-side shutter 201 to slide and retract axially, thereby exposing the toner outlet port 101, as shown in FIG. 6.

10 The main body-side shutter 201 is rotated by the driving mechanism 200 to transfer the rotational force to the toner cartridge 100. The toner replenishment port (not shown) of the machine main body is formed below the main body-side shutter 201. Every time the main body-side shutter opening 202 and toner outlet port 101 rotate and face down, toner in the toner cartridge 100 is discharged from the toner outlet port 101 and main body-side shutter opening 202. The toner is supplied to the machine main body through the toner replenishment port of the machine main body. In other words, the toner is intermittently supplied by rotation of the toner cartridge 100.

20  
25 The toner cartridge driving mechanism 200 having the coupling structure formed integrally with the main body-side shutter 201 can decrease the number of components for rotating the toner cartridge 100, compared to a structure using a dedicated driving mechanism. This can reduce the product cost.

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In dismounting the toner cartridge 100 from the machine main body, the cartridge-side shutter 102 is caught by the main body-side shutter 201 to slide forward and covers the toner outlet port 101. For this  
5 reason, toner does not scatter in dismounting the toner cartridge 100 from the machine main body.

To effectively replenish the developing unit with toner in the toner cartridge 100, a diameter a of the toner outlet port 101 of the toner cartridge 100,  
10 a diameter b of the main body-side shutter opening 202, and a diameter c of the toner replenishment port of the machine main body preferably satisfy a relation of  $a \leq b \leq c$ . When the hole is also formed in the cartridge-side shutter 102, as described above,  
15 a diameter d of this hole and the above holes preferably satisfy a relation of  $a \leq d \leq b \leq c$ .

If the main body-side shutter 201 is made of an elastic material such as rubber, it can function as a vibration insulator, and airtightness between the  
20 main body-side shutter 201 and the toner cartridge 100 can be enhanced. A conventional main body-side shutter is made of a flexible material such as plastic, and this material cannot satisfactorily enhance airtightness. By changing such material to rubber  
25 (natural rubber or silicone rubber), thermal deformation can be greatly suppressed.

FIG. 9 is a perspective view showing a toner

cartridge according to another embodiment of the present invention. In the toner cartridge shown in FIG. 9, a spiral 302 is formed on the inner surface of a constricted portion 301 of a toner cartridge 300 that fits with the machine main body. With this structure, the toner cartridge 300 is automatically dismounted from the machine main body by rotating the toner cartridge 300 counterclockwise.

In this case, claws 303 are attached near the other end of the toner cartridge 300. In counterclockwise rotation, the claws 303 are caught by the machine main body to stop rotation of the toner cartridge 300. However, the rotational force still acts to push the toner cartridge 300 in a direction indicated by an arrow by the operation of the spiral 302.

The toner cartridge 300 shown in FIG. 9 is axially supported by a roller 303. This roller 303 can be made of an elastic member such as rubber to obtain a high acoustic insulation effect.

FIGS. 10 and 11 are a sectional view and perspective view, respectively, showing the end of a toner cartridge according to still another embodiment of the present invention.

In a toner cartridge 400 shown in FIG. 10, a disconnection-prevention rib (projection) 404 is attached near the end of a constricted portion 401

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- of the toner cartridge 400 in order to prevent  
a cartridge-side shutter 402 from slipping off  
the constricted portion 401 of the toner cartridge 400.  
When the cartridge-side shutter 102 slides on  
5 the surface of the constricted portion 401 to close  
a toner outlet port 403, the disconnection-prevention  
rib 404 prevents the cartridge-side shutter 402 from  
slipping off the constricted portion 401 of the toner  
cartridge 400.
- 10 A position where the stopper rib 404 is formed is  
a position where the cartridge-side shutter 402  
completely covers the toner outlet port 403 when  
the cartridge-side shutter 402 slides toward the  
constricted portion 401 to a maximum degree.
- 15 The stopper rib 404 may be formed into a ring  
shape on the entire constricted portion 401 of the  
toner cartridge 400, but may be one or a plurality of  
projections.

FIG. 11 shows still another embodiments of  
20 a toner cartridge having a disconnection-prevention  
structure for the cartridge-side shutter. In a toner  
cartridge 500 shown in FIG. 11, the surface of  
a constricted portion 501 and the inner surface of  
a cartridge-side shutter 502 are threaded. Rotation of  
25 the cartridge-side shutter 502 moves the cartridge-side  
shutter 502 to open/close a toner outlet port 503.  
Movement of the cartridge-side shutter 502 is stopped

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at an unthreaded portion.

As has been described in detail above, the toner cartridge of the present invention has two, cartridge-side shutter and main body-side shutter.

5 Before mounting the toner cartridge in the developing unit, the toner outlet port of the toner cartridge is kept closed by the cartridge-side shutter. The toner replenishment port of the developing unit is kept closed by the main body-side shutter. Only in  
10 mounting/dismounting the toner cartridge on/from the developing unit, the toner outlet port of the toner cartridge and the toner replenishment port of the developing unit are opened/closed. Accordingly, toner can be effectively prevented from scattering in the  
15 developing unit in mounting/dismounting the toner cartridge on/from the developing unit.

Since the toner cartridge driving mechanism and main body-side shutter are integrated, the number of components can be decreased to reduce the cost.

20 Further, if particularly the main body-side shutter is made of an elastic material, it can function as a vibration isolator. At the same time, airtightness between the main body-side shutter and toner cartridge can be enhanced. Thermal deformation  
25 can also be greatly suppressed.

Additional advantages and modifications will readily occur to those skilled in the art. Therefore,

the invention in its broader aspects is not limited to  
the specific details and representative embodiments  
shown and described herein. Accordingly, various  
modifications may be made without departing from the  
spirit or scope of the general inventive concept as  
defined by the appended claims and their equivalents.

the first time in 1990, the U.S. became a net importer of oil.

WHAT IS CLAIMED IS:

1. A developer cartridge which is rotatably mounted in a developing unit of an image forming apparatus, and supplies a developer to said developing unit while rotating, comprising a cylindrical cartridge main body having a developer outlet hole in an outer surface near one end, and a ring-like cartridge-side shutter which is fitted on the outer surface near said one end of said cylindrical cartridge main body to be movable along a rotating shaft of said cylindrical cartridge main body between a position where the developer outlet hole is opened and a position where the developer outlet hole is closed,
- wherein said developing unit has a guide for inserting said developer cartridge and a driving unit for rotating said developer cartridge, said guide has a main body-side shutter with a hole, and when said developer cartridge is mounted, said cartridge-side shutter of said cylindrical cartridge main body moves from the position where the developer outlet hole is closed to the position where the developer outlet hole is opened, the developer outlet hole aligns itself with the hole of said main body-side shutter, and every time said cylindrical cartridge main body and said main body-side shutter integrally rotate to align the developer outlet hole and the hole of said main body-side shutter with a developer replenishment port

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formed below said main body-side shutter, the developer  
in said developer cartridge is supplied from the  
developer replenishment port to said developing unit  
via the developer outlet hole and the hole of said main  
body-side shutter.

2. A developer cartridge according to claim 1,  
wherein a diameter a of the developer outlet hole, a  
diameter b of the hole of said main body-side shutter,  
and a diameter c of the developer replenishment port  
satisfy a relation of  $a \leq b \leq c$ .

3. A developer cartridge according to claim 1,  
wherein said cartridge-side shutter has a hole, and  
fits on said cylindrical cartridge main body so the  
hole is movable between an opening position where the  
hole aligns itself with the developer outlet hole and  
a closing position.

4. A developer cartridge according to claim 3,  
wherein a diameter a of the developer outlet hole, a  
diameter d of the hole of said cartridge-side shutter,  
a diameter b of the hole of said main body-side  
shutter, and a diameter c of the developer replenish-  
ment port satisfy a relation of  $a \leq d \leq b \leq c$ .

5. A developer cartridge according to claim 1,  
wherein a spiral is formed on an inner surface of said  
cylindrical cartridge main body.

6. A developer cartridge according to  
claim 1, wherein said guide and said driving unit

are integrated.

7. A developer cartridge according to claim 1,  
wherein a toner scattering prevention seal is attached  
near the developer outlet hole of said cylindrical  
cartridge main body.

8. A developer cartridge according to claim 1, wherein said main body-side shutter is made of an elastic material.

9. A developer cartridge according to claim 1,  
10 wherein said cylindrical cartridge main body is  
supported by a roller which is in contact with the  
outer surface and made of an elastic material.

10. A developer cartridge according to claim 1,  
wherein a projection for preventing said cartridge-side  
shutter from slipping off is formed on the outer  
surface near said one end of said cylindrical cartridge  
main body.

11. A developer cartridge according to claim 1,  
wherein an inner surface of said cartridge-side shutter  
20 and a surface of said cylindrical cartridge main body  
along which said cartridge-side shutter moves are  
threaded to mesh with each other, and said cartridge-  
side shutter is rotated to move on the surface of said  
cylindrical cartridge main body and stops at an  
unthreaded portion.  
25

12. An image forming apparatus comprising  
a developing unit for developing an electrostatic

latent image on an image bearing body with a developer,  
and a transfer unit for transferring the developed  
developer image onto a transfer medium,

wherein said developing unit has a developer  
5 cartridge rotatably mounted to supply the developer  
to said developing unit while rotating, a guide for  
inserting said developer cartridge, and a driving unit  
for rotating said developer cartridge;

10 said developer cartridge has a cylindrical  
cartridge main body having a developer inlet hole  
in an outer surface near one end, and a ring-like  
cartridge-side shutter which is fitted on the outer  
surface near said one end of said cylindrical cartridge  
main body to be movable along a rotating shaft of said  
cylindrical cartridge main body between a position  
15 where the developer outlet hole is opened and a  
position where the developer outlet hole is closed;

said guide has a main body-side shutter with  
a hole; and

20 when said developer cartridge is mounted, said  
cartridge-side shutter of said cylindrical cartridge  
main body moves from the position where the developer  
outlet hole is closed to the position where the  
developer outlet hole is opened, the developer outlet  
25 hole aligns itself with the hole of said main body-side  
shutter, and every time said cylindrical cartridge main  
body and said main body-side shutter integrally rotate

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to align the developer outlet hole and the hole of said main body-side shutter with a developer replenishment port formed below said main body-side shutter, the developer in said developer cartridge is supplied from  
5 the developer replenishment port to said developing unit via the developer outlet hole and the hole of said main body-side shutter.

13. An image forming apparatus according to  
claim 12, wherein a diameter a of the developer outlet  
10 hole, a diameter b of the hole of said main body-side shutter, and a diameter c of the developer replenishment port satisfy a relation of  $a \leq b \leq c$ .

14. An image forming apparatus according to  
claim 12, wherein said cartridge-side shutter has  
15 a hole, and fits on said cylindrical cartridge main body so the hole is movable between an opening position where the hole aligns itself with the developer outlet hole and a closing position.

15. An image forming apparatus according to  
claim 14, wherein a diameter a of the developer outlet  
20 hole, a diameter d of the hole of said cartridge-side shutter, a diameter b of the hole of said main body-side shutter, and a diameter c of the developer replenishment port satisfy a relation of  $a \leq d \leq b \leq c$ .

25 16. An image forming apparatus according to  
claim 12, wherein a spiral is formed on an inner surface of said cylindrical cartridge main body.

17. An image forming apparatus according to  
claim 12, wherein said guide and said driving unit are  
integrated.
18. An image forming apparatus according to  
5 claim 12, wherein a toner scattering prevention seal  
is attached near the developer outlet hole of said  
cylindrical cartridge main body.
19. An image forming apparatus according to  
claim 12, wherein said main body-side shutter is made  
10 of an elastic material.
20. An image forming apparatus according to  
claim 12, wherein said cylindrical cartridge main body  
is supported by a roller which is in contact with the  
outer surface and made of an elastic material.
- 15 21. An image forming apparatus according to  
claim 12, wherein a projection for preventing said  
cartridge-side shutter from slipping off is formed on  
the outer surface near said one end of said cylindrical  
cartridge main body.
- 20 22. An image forming apparatus according to  
claim 12, wherein an inner surface of said cartridge-  
side shutter and a surface of said cylindrical  
cartridge main body along which said cartridge-side  
shutter moves are threaded to mesh with each other, and  
25 said cartridge-side shutter is rotated to move on the  
surface of said cylindrical cartridge main body and  
stops at an unthreaded portion.

ABSTRACT OF THE DISCLOSURE

A developer cartridge which is rotatably mounted in the developing unit of an image forming apparatus, and supplies a developer to the developing unit while

5       rotating includes a cylindrical cartridge main body having a developer outlet hole in the outer surface near one end, and a ring-like cartridge-side shutter which is fitted on the outer surface near one end of the cylindrical cartridge main body to be movable along

10      the rotating shaft of the cylindrical cartridge main body between a position where the developer outlet hole is opened and a position where the developer outlet hole is closed. The developing unit has a guide for inserting the developer cartridge and a driving unit

15      for rotating the developer cartridge, and the guide has a main body-side shutter with a hole. When the developer cartridge is mounted, the cartridge-side shutter moves from the position where the developer outlet hole is closed to the position where the

20      developer outlet hole is opened, and the developer outlet hole aligns itself with the hole of the main body-side shutter. The cylindrical cartridge main body and the main body-side shutter integrally rotate to align the developer outlet hole and the hole of the

25      main body-side shutter with a developer replenishment port formed below the main body-side shutter. Every time this happens, the developer in the developer

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cartridge is supplied from the developer replenishment port to the developing unit via the developer outlet hole and the hole of the main body-side shutter.

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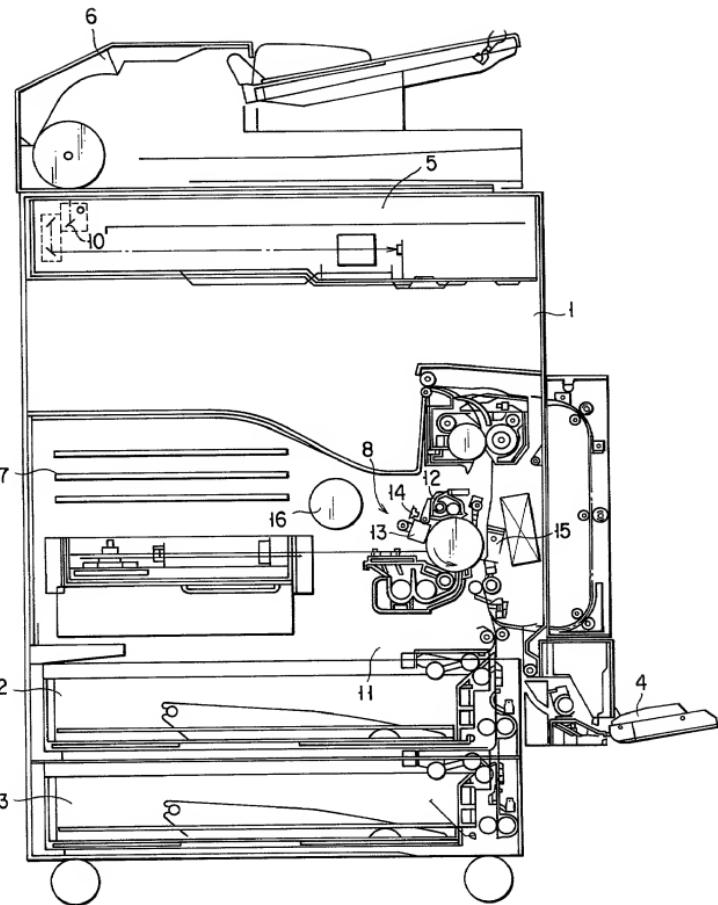


FIG. 1

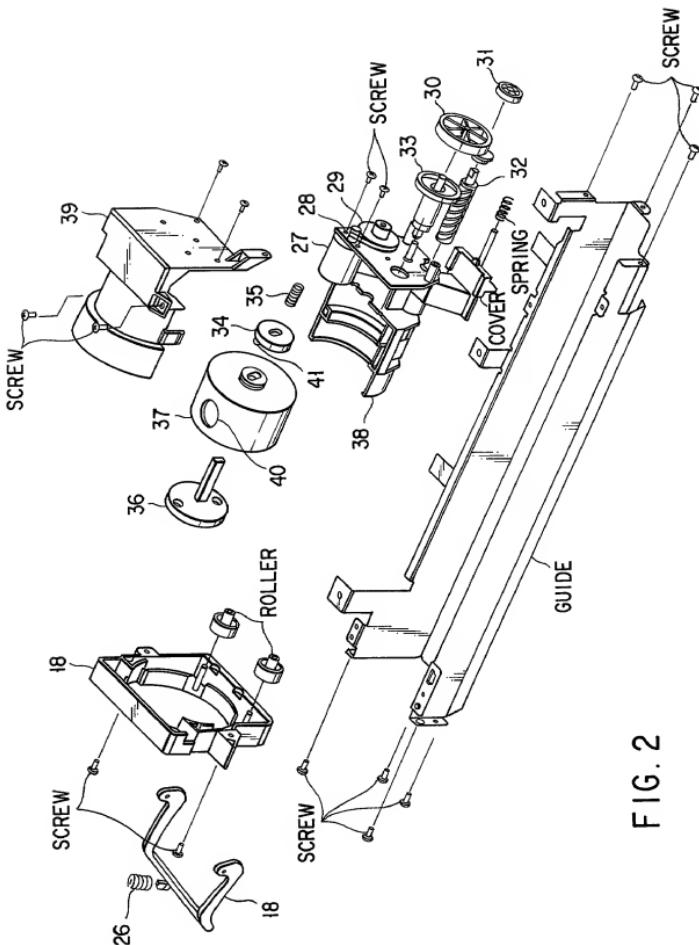


FIG. 2

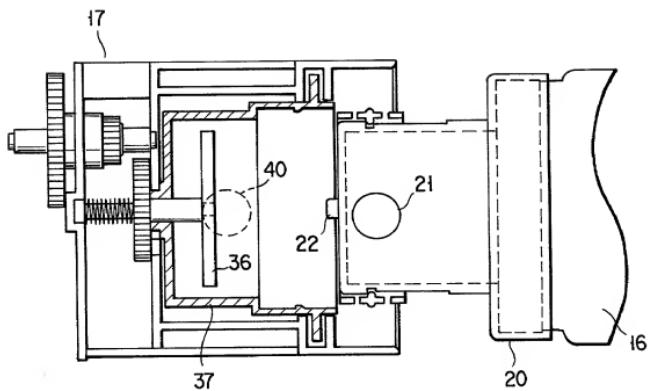


FIG. 3A

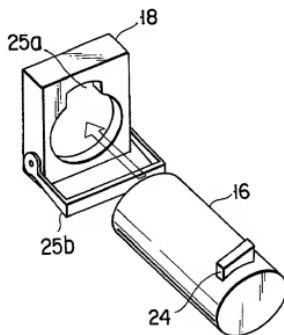


FIG. 3B

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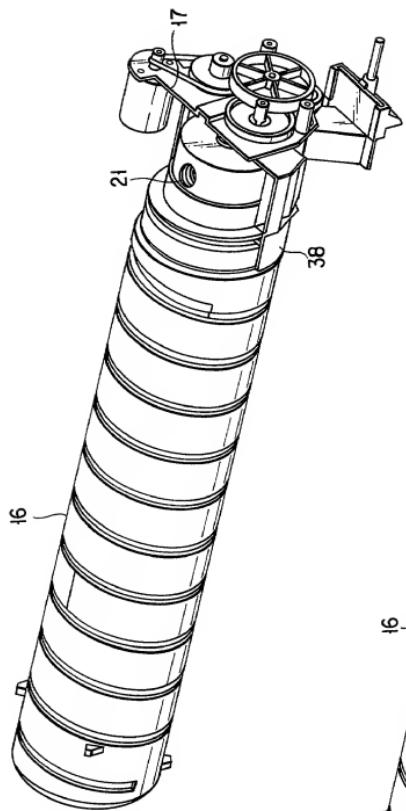


FIG. 4A

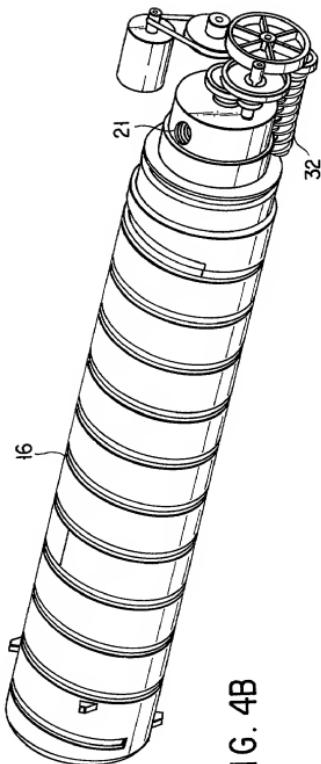
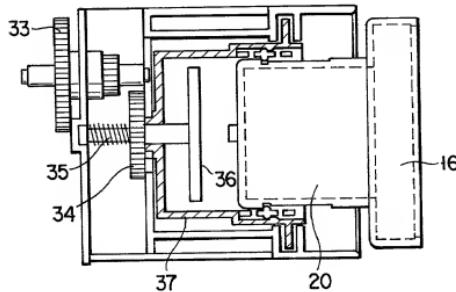
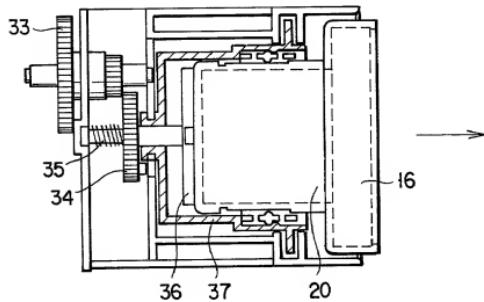
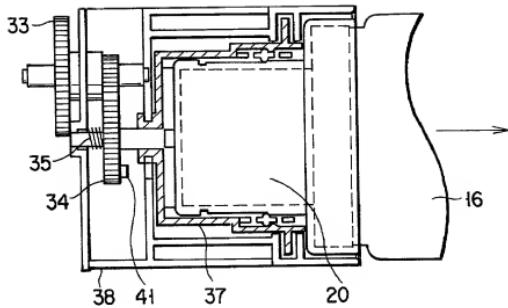


FIG. 4B



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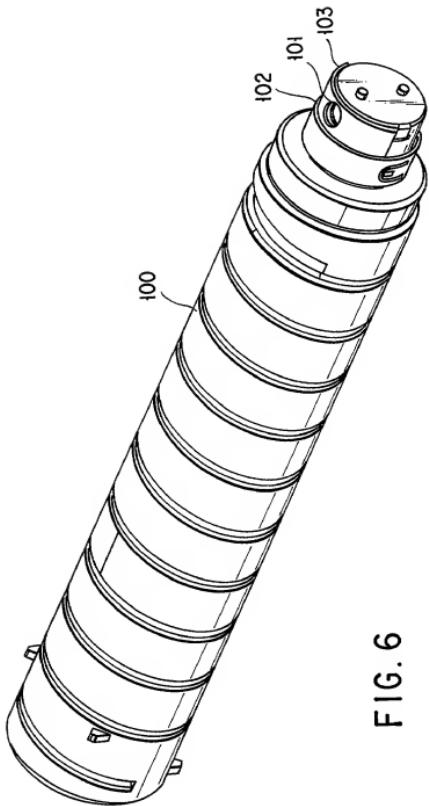
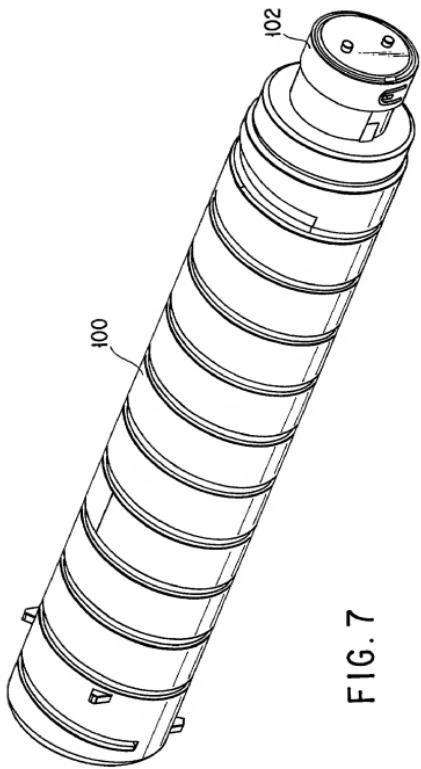


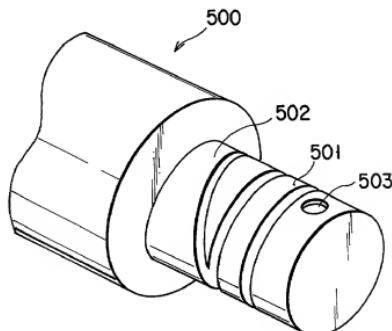
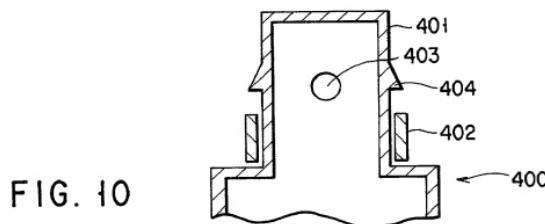
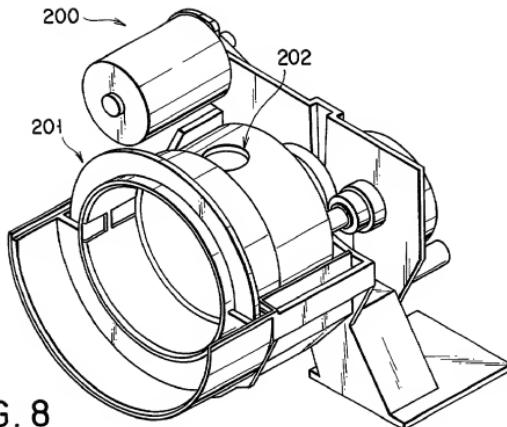
FIG. 6

FIG. 7



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0396327-001800



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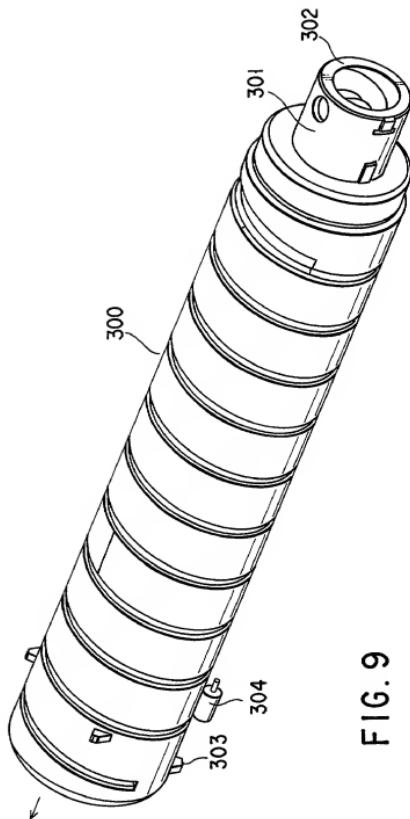


FIG. 9

## DECLARATION FOR PATENT APPLICATION

0050052

As a below named inventor, I declare:  
 that I verily believe myself to be the original, first and sole (if only one individual inventor is listed below) or an original, first and joint inventor (if more than one individual inventor is listed below) of the invention in

## IMAGE FORMING APPARATUS

COPY

JUN 14 2000

the specification of which is attached hereto unless the following box is checked.

was filed on \_\_\_\_\_ as United States Application  
 or PCT International Application No. \_\_\_\_\_, and  
 was amended on \_\_\_\_\_ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information of which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 35 U.S.C. 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed:

Country	Category	Application No.	Filing Date	Priority Claim
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And I hereby appoint Stephen A. Bent (Reg. No. 29,768), David A. Blumenthal (Reg. No. 26,257), William T. Ellis (Reg. No. 26,874), John J. Feldhaus (Reg. No. 28,822), Patricia D. Granados (Reg. No. 33,683), John P. Isaacson (Reg. No. 33,715), Eugene M. Lee (Reg. No. 32,039), Richard Linn (Reg. No. 25,144), Peter G. Mack (Reg. No. 26,001), Brian J. McNamara (Reg. No. 32,789), Sybil Meloy (Reg. No. 22,749), George E. Quillin (Reg. No. 32,792), Colin G. Sandercock (Reg. No. 31,298), Bernhard D. Saxe (Reg. No. 28,665), Charles F. Schill (Reg. No. 27590), Richard L. Schwaab (Reg. No. 25,479), Arthur Schwartz (Reg. No. 22,115) and Harold C. Wegner (Reg. No. 25,258), each of whose address is Suite 500, 3000 K Street, N.W. Washington, D.C. 20007-5109, or any one of them, my attorneys with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent & Trademark Office connected therewith, and request that correspondence be directed to Foley & Lardner, Suite 500, 3000 K Street, N.W. Washington, D.C. 20007-5109.

I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

## DECLARATION FOR PATENT APPLICATION

I declare further that my citizenship, residence and post office address are as stated below next to my name:

Inventor: (Signature)	Date	Residence and post office address
Tokihiko Ise Tokihiko Ise	Date: Feb. 16, 2000	1-17, Rokkakubashi Kazoku Apart. 40, Saitobuncho, Kanagawa-ku, Yokohama-shi, Kanagawa-ken, Japan
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	Date:	
	Citizen of: Japan	
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	Date:	
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